

PATENT COOPERATION TREATY PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)



Applicant's or agent's file reference PC-9519	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/JP2005/004894	International filing date(<i>day/month/year</i>) 14.03.2005	(Earliest) Priority Date (<i>day/month/year</i>) 15.03.2004
Applicant SHOWA DENKO K.K.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box II).

3. ☐ **Unity of invention is lacking** (See Box III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the drawings to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/004894

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ H01L33/00 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ H01L33/00 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2005 Registered utility model specifications of Japan 1996-2005 Published registered utility model applications of Japan 1994-2005 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) JICST (JOIS)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5008718 A (Robert M. Fletcher et.al.) 1991.04.16, column2 line48 - column3 line13, Fig.2 & EP 434233 A1	1-10
Y	JP 2002-368260 A (Showa Denko K.K.) 2002.12.20, 【0020】 (none patent family)	1
Y	JP 2003-309284 A (Showa Denko K.K.) 2003.10.31, 【0010】 - 【0012】, 【0020】, 【0030】 (none patent family)	1-10
Y	JP 2004-47760 A (Hitachi Cable) 2004.02.12, 【0006】 (none patent family)	6
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
<p>* Special categories of cited documents:</p> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“E” earlier application or patent but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p> <p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&” document member of the same patent family</p>		
Date of the actual completion of the international search 12.04.2005		Date of mailing of the international search report 10.5.2005
Name and mailing address of the ISA/JP Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan		Authorized officer Kazuyo KADOTA Telephone No. +81-3-3581-1101 Ext. 3255
		2K 9512

INTERNATIONALSEARCHREPORT

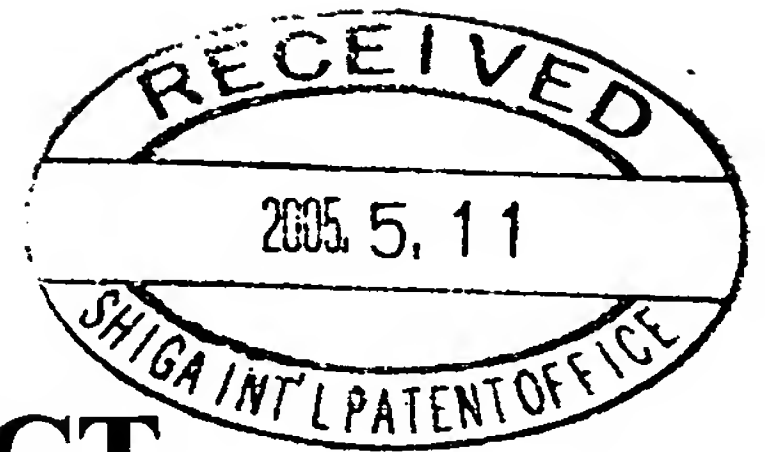
International application No.

PCT/JP2005/004894

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-186601 A (Showa Denko K.K.) 1999.07.09, 【0040】, 【0045】 (none patent family)	8

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY



PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)

To:
SHIGA Masatake

2-3-1, Yaesu, Chuo-ku, Tokyo
1048453 Japan

Date of mailing
(day/month/year) 10.5.2005

Applicant's or agent's file reference
PC-9519

FOR FURTHER ACTION

See paragraph 2 below

International application No.
PCT/JP2005/004894

International filing date (day/month/year)
14.03.2005

Priority date (day/month/year)
15.03.2004

International Patent Classification (IPC) or both national classification and IPC
Int.Cl.⁷ H01L33/00

Applicant
SHOWA DENKO K.K.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Date of completion of this opinion 12.04.2005

Name and mailing address of the ISA/JP

Japan Patent Office

3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan

Authorized officer

Kazuyo KADOTA

Telephone No. +81-3-3581-1101 Ext. 3255

2K 9512

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/JP2005/004894

Box No. I Basis of the opinion

1. With regard to the language, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This opinion has been established on the basis of a translation from the original language into the following language _____, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

- ☐ a sequence listing
☐ table(s) related to the sequence listing

b. format of material

- ☐ in written format
☐ in computer readable form

c. time of filing/furnishing

- ☐ contained in the international application as filed.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

WRITTEN OPINION OF THE
 INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/JP2005/004894

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-10	YES
	Claims		NO
Inventive step (IS)	Claims		YES
	Claims	1-10	NO
Industrial applicability (IA)	Claims	1-10	YES
	Claims		NO

2. Citations and explanations

(1) Claim 1

A compound semiconductor LED comprising a light-emitting layer of AlGaInP (22), an upper p-type confining layer of AlGaInP (23), and a p-type window layer (24) is disclosed in the document 1, which is described in the international search report (ISR).

Document 1: US 5008718 A (Robert M. Fletcher et.al.) 1991.04.16,
 column2 line48 - column3 line13, Fig.2 & EP 434233 A1

The window layer said above is a III-V semiconductor alloy different from AlGaInP and having a bandgap greater than that of the active layer of the LED so as to be transparent to the light emitted by the p-n junction of the LED, and also having a higher electrical conductivity (lower resistivity) than the AlGaInP, according to the document 1. Therefore the window layer said above is also playing the roll of a current diffusion layer.

In the document 2 described in the ISR a III-V semiconductor layer comprising boron is disclosed, which is, for example, BP (boron-phosphide) layer, having about 3eV bandgap energy, as light-emitting transparent layer where to be transparent to the light wave longer than about 413nm from a light-emitting layer, for example, of GaP (about 555nm) in the LED.

Document 2: JP 2002-368260 A (Showa Denko K.K.) 2002.12.20, 【0020】
 (none patent family)

In the document 3 (especially seen in 【0011】) described in the ISR BP-based semiconductor layer is transparent to the light corresponding to the bandgap narrower than that of BP-based semiconductor layer said above, and playing the roll of a window layer which is to be transparent to the light emitting in the LED.

(continued)

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box No. V 2.

Document 3: JP 2003-309284 A (Showa Denko K.K.) 2003.10.31,
【0010】 - 【0012】 , 【0020】 , 【0030】 (none patent family)

Considering the description in the document 2 and 3 said above the person skilled in the art would easily conceive the idea of adopting a BP-based semiconductor as a current diffusion layer as well as a window layer in the LED described in the document 1.

(2) Claim2, 7

In the document 3 (especially seen in 【0010】) is described that the BP-based semiconductor layer is composed of $B_{\alpha}Al_{\beta}Ga_{\gamma}In_{1-\alpha-\beta-\gamma}P_{1-\delta}As_{\delta}$ ($0 < \alpha \leq 1$, $0 \leq \beta < 1$, $0 \leq \gamma < 1$, $0 < \alpha + \beta + \gamma \leq 1$, $0 \leq \delta < 1$), especially BP, BPGa, or BPN is shown.

(3) Claim3-4

The feature of claim3 or 4 is disclosed in the document 3, seen in 【0011】 .

(4) Claim5

Among the feature of claim5 carrier concentration and resistivity are disclosed in the document 3, seen in 【0012】 , while 450nm is exemplified as thickness in the same document, seen in 【0030】 .

(5) Claim6

It is widely known among the skilled person in the art that the current diffusion layer overlying the upper cladding layer has a bandgap energy wider than that of upper cladding layer, for example, seen in the document 4.

Document 4: JP 2004-47760 A (Hitachi Cable) 2004.02.12, 【0006】
(none patent family)

(6) Claim8

It is widely known among the skilled person in the art that a compositional gradient layer is overlying on the light emitting layer, for example, seen in the document5 described in the ISR.

Document 5: JP 11-186601 A (Showa Denko K.K.) 1999.07.09,
【0040】 , 【0045】 (none patent family)

(continued)

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box No. V 2.

(7) Claim 9

It is disclosed in the document 3, seen in 【0012】 , that the conductive BP-based semiconductor layer is undoped, where no impurity element is intentionally added.

(8) Claim 10

It is disclosed in the document 3, seen in 【0020】 , that the Ohmic contact electrode is fabricated over the BP-based semiconductor layer.